WHAT IS CLAIMED IS:

1. A projection exposure apparatus comprising:

an illumination optical system, including a light source, for irradiating a mask with illumination light;

a projection optical system for projecting an image of hyperfine patterns provided on said mask on a substrate;

an optical integrator, provided in said illumination optical system, for illuminating said mask in a homogeneous illuminance distribution; and

a luminous flux distributing member for distributing the luminous fluxes from said optical integrator into at least two luminous fluxes traveling in direction different from each other for concentrating intensity distributions over a Fourier transform corresponding surface for said hyperfine patterns within said illumination system or over a surface in the vicinity of the position thereof on at least two portions apart from an optical axis of said illumination optical system,

characterized in that said luminous flux distributing member is interposed between said optical integrator and said mask in a light path of said illumination optical system.

2. The projection exposure apparatus as set forth in claim 1, wherein the positions on which said intensity

distributions are concenrated and the number of the portions on which said intensity distributions are concentrated are set in accordance with a degree of fineness of said hyperfine patterns.

3. The projection exposure apparatus as set forth in claim 1, wherein said luminous flux distributing member includes at least one of a diffraction grating pattern plate, fibers capable of splitting the luminous flux into a plurality of beams, a prism and a mirror.

4. The projection exposure apparatus as set forth in claim 1, further comprising: an image deteriorating means for making unsharp an image of said luminous flux distributing member which is formed on said mask due to said illumination optical system.

5. The projection exposure apparatus as set forth in claim 4, wherein said luminous flux distributing means is a diffraction grating pattern plate, and said image deteriorating means makes unsharp the image of said diffraction grating pattern plate within a range larger than the degree of fineness of said hyperfine patterns.

6. A projection exposure apparatus comprising:

an illumination optical system, including a light source, for irradiating a mask with illumination light;

a projection optical system for projecting an imag of hyperfine patterns provided on said mask on a

substrate;

an optical integrator, provided in said illumination optical system, for illuminating said mask in a homogeneous illuminance distribution; and

a luminous flux distributing member for distributing the luminous fluxes from said light source into at least two luminous fluxes for concentrating intensity distributions over a Fourier transform corresponding surface for said hyperfine patterns within said illumination system or over a surface in the vicinity of the position thereof on at least two portions apart from an optical axis of said illumination optical system,

characterized in that said luminous flux distributing member is interposed between said light source and said mask in a light path of said illumination optical system.

7. The projection exposure apparatus as set forth in claim 6, further comprising: a spatial filter provided in the vicinity of an incident surface or an exit surface of said optical integrator and having its transmissive portions formed in the portions on which said luminous fluxes from said luminous flux distributing member are concentrated and its light shielding portions formed in other portions.

8. A projection exposure apparatus comprising:

an illumination optical system, including a light source, for irradiating a mask with illumination light;

a projection optical system for projecting an image of hyperfine patterns provided on said mask on a substrate;

a plurality of optical integrator groups for forming secondary illuminant images separated from each other on the Fourier transform corresponding surface for said hyperfine patterns or in the vicinity of the position thereof, said plurality of optical integrator groups being provided in said illumination optical system and serving to illuminate said mask in a homogeneous illuminance distribution;

a position adjusting member for setting respective centers of said plurality of optical integrator groups in discrete positions eccentric from an optical axis of an optical system of said illumination optical system or said projection optical system; and

an input optical system for making said illumination light from said light source incident on at least said two optical integrator groups among said plurality of optical integrator groups after being set by said position adjusting member.

9. The projection exposure apparatus as set forth in claim 8, wherein said input optical system focuses said illumination light from said light source on at least said two optical integrator groups, respectively.

10. The projection exposure apparatus as set forth in claim 8, fruther comprising: a drive member for moving at least a part of said input optical system to concentrate said illumination light from said light source on at least said two optical integrator groups with deviations in time with respect to each other until completing an exposure of said patterns for said substrate.

11. The projection exposure apparatus as set forth in claim 8, wherein respective centers of said plurality of optical integrator groups, the discrete positions eccentric from said optical axis and the number of said plurality of optical integrator groups are set in accordance with the degree of fineness of said hyperfine patterns.

12. The projection exposure apparatus as set forth in claim 8, further comprising: a spatial filter, provided in the vicinity of an incident surface or an exit surface of said optical integrator group, in which the portions on which the illumination luminous fluxes from said input optical system are concentrated are transmissive portions, while other portions are light shielding portions.

13. The projection exposure apparatus as set forth in claim 12, wherein a transmissivity of said one or more transmissive portions of said spatial filter is made different from transmissivities of other transmissiv portions.

14. The projection exposure apparatus as set forth in claim 8, further comprising: a second optical integrator provided in said illumination optical system defined from said light source to said input optical system.

15. The projection exposure apparatus as set forth in claim 8, wherein said plurality of optical integrator groups are composed of 2m-numbered (however, $m \geqq 1$) optical integrator groups, the respective centers of said m-numbered optical integrator groups among said 2m-numbered optical integrator groups are eccentrically disposed on said Fourier transform corresponding surface in said illumination optical system or on a surface in the vicinity of the position thereof so that light components, 0th-order diffracted light component generated from the patterns of said mask and at least one of (±) primary diffracted light components expanding at an angle corresponding to the degree of fineness of said patterns with respect to said 0th-order diffracted light component, are distributed at substantially equal distances from said optical axis over said Fourier transform surface in said projection optical system for said mask patterns or over the surface in the vicinity thereof, and the centers of said remaining m-numbered optical integrator groups and the centers of said former m-numbered optical integrator groups are disposed

substantially in symmetry with respect to said optical axis.

16. The projection exposure apparatus as set forth in claim 8, wherein when paying attention to the diffracted light generated from said mask upon the irradiation of said illumination light, the center of said one arbitrary optical integrator group is disposed eccentrically from said optical axis so that three diffracted light components, i.e, said 0th-order diffracted light component distributed over said Fourier transform surface in said projection optical system or the surface in the vicinity thereof, one of higher-order diffracted light components than said primary diffracted light component which are distributed in a first direction over said Fourier transform surface in said projection optical system or over the surface in the vicinity thereof about said 0th-order diffracted light component while depending on a two-dimensional periodic structure of said mask patterns and one of higher-order diffracted light components than said primary diffracted light component which are distributed in a second direction intersecting said first direction over said Fourier transform surface in said projection optical system or over the surface in the vicinity thereof about said 0th-order diffracted light component, are distributed at substantially equal

distances from said optical axis over said Fourier transform surface in said projection optical system for said mask patterns or over the surface in the vicinity thereof.

17. The projection exposure apparatus as set forth in claim 8, wherein a ratio of a numerical aperture of the luminous fluxes from each of said plurality of optical integrator groups to a mask-side numerical aperture of said projection optical system is 0.1 through 0.3.

18. A projection exposure apparatus comprising:

an illumination optical system, including a light source, for irradiating a mask with illumination light;

a projection optical system for projecting an image of hyperfine patterns provided on said mask on a substrate;

a plurality of optical integrator groups for forming secondary illuminant images separated from each other on a Fourier transform surface for said hyperfine patterns or a surface in the vicinity thereof, said plurality of optical integrator groups being provided in said illumination optical system and serving to illuminate said mask in a homogeneous illuminance distribution;

a holding member for integrally holding said plurality of optical integrator groups so that respective centers of said plurality of integrator groups are set in

discrete positions eccentric from an optical axis of an optical system of said illumination optical system or said projection optical system; and

an input optical system for making the illumination light from said light source incident on at least said two optical integrator groups among said plurality of optical integrator groups set by said holding member.

19. The projection exposure apparatus as set forth in claim 18, wherein said input optical system concentrates the illumination light from said light source on at least said two optical integrator groups, respectively.

20. The projection exposure apparatus as set forth in claim 18, wherein said holding member holds said input optical system integrally with at least said two optical integrator groups.

21. A projection exposure apparatus comprising:

an illumination optical system, including a light source, for irradiating a mask with illumination light;

a projection optical system for projecting an image of hyperfine patterns provided on said mask on a substrate;

a plurality of optical integrator groups for forming secondary illuminant images separated from each other on a Fourier transform corresponding surface for said hyperfine pattern or a surface in the vicinity thereof, said

plurality of optical integrator groups being provided in said illumination optical system and serving to illuminate said mask in a homogeneous illuminance distribution;

a plurality of holding members each for integrally holding said plurality of optical integrator groups so that respective centers of said plurality of optical integrator groups are set in discrete positions eccentric from an optical axis of an optical system of said illumination optical system or said projection optical system;

an input optical system for making the illumination light from said light source incident on at least said two optical integrator groups among said plurality of optical integrator groups set by said holding members; and

a switching member for exchangeably placing each of said plurality of holding members in a light path of said illumination optical system;

characterized in that said holding members respectively hold said plurality of optical integrator groups while making eccentric quantities thereof from each other.

22. The projection exposure apparatus as set forth in claim 21, wherein said input optical system concentrates the illumination light from said light source on at least said two optical integrator groups.

23. The projection exposure apparatus as set forth in claim 21, wherein said holding member holds said input optical system integrally with at least said two optical integrator groups.

24. A projection exposure apparatus comprising:

an illumination optical system, including a light source, for irradiating a mask with illumination light;

a projection optical system for projecting an image of hyperfine patterns provided on said mask on a substrate;

optical integrators, provided in said illumination optical system, for illuminating said mask in a homogeneous illuminance distribution, said optical integrators including at least two integrators of a first optical integrator for forming a secondary illuminant image about an optical axis of an optical system of said illumination optical system or said projection optical system on a Fourier transform corresponding surface for said hyperfine patterns or a surface in the vicinity of the position thereof and a second optical integrator consisting of a plurality of optical integrator groups for forming illuminant images separated from each other on said Fourier transform corresponding surface for said hyperfine patterns or on the surface in the vicinity of the position thereof;

a plurality of holding members including at least two holding members of a first holding member for holding said first optical integrator and a second holding member for integrally holding said plurality of optical integrator groups so that respective centers of said plurality of optical integrator groups of said second optical integrator are set in discrete positions eccentric from said optical axis of said optical system of said illumination optical system or said projection optical system;

a first switching member for exchangeably placing each of said plurality of holding members in a light path of said illumination optical system;

a first input optical system for concentrating the illumination light from said light source on said first optical integrator;

a second input optical system for concentrating the illumination light from said light source on said second optical integrator; and

a second switching member for exchangeably placing said first input optical system and second input optical system in accordance with said plurality of holding members disposed in the light path of said illumination optical system by said first switching member.

25. The projection exposure apparatus as set forth in

claim 24, wherein said second holding member holds said second input optical system integrally at least with said two optical integrator groups.

26. A projection exposure apparatus comprising:

an illumination optical system, including a light source, for irradiating a mask with illumination light;

a projection optical system for projecting an image of hyperfine patterns provided on said mask on a substrate;

an optical integrator, provided in said illumination optical system, for illuminating said mask in a homogeneous illuminance distribution;

a movable optical member for making the luminous flux from said optical integrator incident on a Fourier transform corresponding surface for said hyperfine patterns within sail illumination optical system or on a surface in the vicinity of the position thereof; and

a drive member for moving said movable optical member to concentrate intensity distributions over said Fourier transform corresponding surface or over the surface in the vicinity of the position thereof on at least two portions apart from an optical axis of said illumination optical system with deviations in time from each other until completing an exposure of said patterns for said substrate,

characterized in that said movable optical member is provided between said optical integrator and said mask in the light path of said illumination optical system.

27. The projection exposure apparatus as set forth in claim 26, wherein the positions on which said intensity distributions are concentrated and the number of said intensity distribution concentrating positions are set in accordance with the degree of fineness of said hyperfine pattern.

28. The projection exposure apparatus as set forth in claim 26, wherein said movable optical member includes at least one of a mirror, a fiber and a lens.

29. A projection exposure apparatus comprising:

an illumination optical system, including a light source, for irradiating a mask with illumination light;

a projection optical system for projecting an image of hyperfine patterns provided on said mask on a substrate;

an optical integrator, provided in said illumination optical system, for illuminating said mask in a homogeneous illuminance distribution;

a movable optical member for making the luminous flux from said optical integrator incident on a Fourier transform corresponding surface for said hyperfine patterns within said illumination optical system or a surface in the vicinity of the position thereof; and

a drive member for moving said movable optical member to concentrate intensity distributions over a Fourier transform corresponding surface or a surface in the vicinity of the position thereof on at least two portions apart from an optical axis of said illumination optical system with deviations in time from each other until completing an exposure of said patterns for said substrate,

characterized in that said movable optical member is provided between said light source and said optical integrator in a light path of said illumination optical system.

30. An exposure method using a projection exposure apparatus constructed to expose patterns of a mask onto an exposed member through a projection optical system by moving a movable optical member for changing incident angles of illumination luminous fluxes on said mask in an illumination optical system, said exposure method comprising:

a first step of: starting the exposure in a state where said movable optical member is set in a first position;

a second step of switching said movable optical member from said first position to a predetermined second position different from said first position after irradiating said mask with a predetermined quantity of

luminous fluxes or for a predetermined period;

a light shielding step of shielding the illumination light during said switching process; and

a step of finishing the irradiation of said mask with the luminous fluxes just when an exposure quantity given to said exposed member reaches a predetermined value upon setting said movable optical member to said first and second positions, respectively.

31. The exposure method as set forth in claim 30, wherein a plurality of switching operations of said movable optical member to said first and second positions are effected every time said mask is irradiated with the luminous fluxes with the predetermined quantity or for the predetermined period.

32. The exposure method as set forth in claim 30, wherein said plurality of predetermined positions of said movable optical member are determined so that a 0th-order diffracted light component generated from said patterns upon the irradiation of the luminous fluxes and primary diffracted light components pass through positions having substantially equal distances from an optical axis of said projection optical system on said Fourier transform surface for said mask patterns in said projection optical system or on the surface in the vicinity thereof.

33. The exposure method as set forth in claim 30,

wherein said mask depicted with patterns having periodicity in two-dimensional directions is used, and said plurality of predetermined positions of said movable optical member are determined so that said 0th-order diffracted light component generated from said patterns upon the irradiation of said luminous fluxes and said two primary diffracted light components are pass through the positions having substantially equal distances from said optical axis of said projection optical system on said Fourier transform surface for said mask patterns in said projection optical system or on the surface in the vicinity thereof.

34. An exposure method using a projection exposure apparatus constructed to expose patterns of a mask to an exposed member through a projection optical system by moving a movable member for changing incident angles of illumination luminous fluxes on said mask in an illumination optical system, said exposure method comprising:

a step of starting said exposure in a state where said movable optical member is set in a predetermined first position;

a step of stopping said exposure every time said mask is irradiated with said luminous fluxes with a predetermined quantity or for a predetermined period;

a step of setting said movable optical member in a

predetermined second position different from said first position during the stoppage of said exposure and thereafter resuming said exposure; and

finishing the irradiation of said mask with the luminous fluxes just when an exposure quantity given to said exposed member reaches a predetermined value upon setting said movable optical member in said first and second positions, respectively.

35. In an exposure method of effecting an exposure with a predetermined amount of deviation of a substrate at a predetermined velocity from an image forming surface of mask patterns in an optical-axis direction of a projection optical system when exposing hyperfine patterns of a mask onto said substrate by use of a projection exposure apparatus including an illumination system for illuminating said mask and said projection optical system for projecting a hyperfine pattern image of said illuminated mask on said substrate,

the improvement characterized in that said mask is irradiated obliquely with the illumination light, and any one of (+) primary diffracted light components generated from said hyperfine patterns of said illuminated mask and an 0th-order diffracted light component pass mutually at equal distances from the optical axis of said projection optical system on a Fourier transform surface in said

projection optical system for said mask hyperfine patterns or a surface in the vicinity thereof.

36. A projection exposure apparatus comprising:

an illumination optical system, including a light source, for irradiating a mask with illumination light;

a projection optical system for projecting an image of hyperfine patterns provided on said mask on a substrate; and

a luminous flux distributing member for distributing luminous fluxes from said light source into four luminous fluxes traveling in directions different from each other for concentrating intensity distributions over a Fourier transform corresponding surface for hyperfine patterns in said illumination optical system or a surface in the vicinity of the position thereof on at least four portions apart from an optical axis of said illumination optical system,

characterized in that said luminous flux distributing member determines the traveling directions of said four luminous fluxes so that respective centers of said two luminous fluxes among said four luminous fluxes pass through eccentric positions on said Fourier transform corresponding surface in said illumination optical system or on the surface in the vicinity of the position thereof so as to distribute a 0th-order diffracted light component

generated from said mask patterns and at least one of (+) primary diffracted light components expanding at an angle corresponding to a degree of fineness of said patterns for said 0th-order diffracted light component at substantially equal distances from said optical axis on said Fourier transform surface in said projection optical system for said mask patterns or on the surface in the vicinity thereof, and at the same time the centers of said remaining two luminous fluxes pass through such positions as to exhibit almost a symmetry between the centers of said former two luminous fluxes and the centers of said remaining two luminous fluxes with respect to said optical axis.

37. The projection exposure apparatus as set forth in claim 36, wherein when paying attention to the diffracted light generated from said mask upon the irradiation of one beam of illumination light from said luminous flux distributing member, said luminous flux distributing member determines a traveling direction of said one arbitrary luminous flux so that three diffracted light components i.e. said 0th-order diffracted light component distributed over said Fourier transform surface in said projection optical system or over the surface in the vicinity thereof, one of higher-order diffracted light components than said primary diffracted light component which are distributed in a

first direction over said Fourier transform surface in said projection optical system or over the surface in the vicinity thereof about said 0th-order diffracted light component while depending on a two-dimensional periodic structure of said mask patterns and one of higher-order diffracted light components than said primary diffracted light component which are distributed in a second direction intersecting said first direction over said Fourier transform surface in said projection optical system or over the surface in the vicinity thereof about said 0th-order diffracted light component are distributed at substantially equal distances from said optical axis over said Fourier transform surface in said projection optical system for said mask patterns or over the surface in the vicinity thereof.

38. A projection exposure apparatus comprising:

an illumination optical system, including a light source, for irradiating a mask with illumination light;

a projection optical system for projecting an image of hyperfine patterns provided on said mask on a substrate;

a luminous flux distributing member for distributing luminous fluxes from said light source into two luminous fluxes traveling in directions different from each other for focusing intensity distributions on a Fourier

transform corresponding surface for said hyperfine patterns in said illumination optical system or on a surface in the vicinity of the position thereof on at least two portions apart from said optical axis of said illumination optical system; and

an adjusting member for adjusting a positional relation between said two portions.

39. The projection exposure apparatus as set forth in claim 38, wherein said adjusting member drives said luminous flux distributing member in accordance with said hyperfine patterns of said mask.

40. The projection exposure apparatus as set forth in claim 38, wherein said adjusting member exchanges said luminous flux distributing member in accordance with said hyperfine patterns of said mask.

41. A projection exposure apparatus comprising:

an illumination optical system, including a light source, for irradiating a mask with illumination light;

a projection optical system for projecting an image of hyperfine patterns provided on said mask on a substrate;

a luminous flux distributing member for distributing luminous fluxes from said light source into two luminous fluxes traveling in directions different from each other for focusing intensity distributions on a Fourier

transform surface for said hyperfine patterns in said illumination optical system or on a surface in the vicinity of the position thereof at least two portions apart from an optical axis of said illumination optical system;

an optical member for limiting said intensity distributions on said Fourier transform corresponding surface for said hyperfine patterns in said illumination optical system or on said surface in the vicinity of the position thereof within a predetermined region including said optical axis of said illumination optical system; and

a drive means for switching said luminous flux distributing member and said optical member.